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as appendix C

IN THE UNITED STATES INTERNATIONAL PRELIMINARY
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PCT/US98/25088	24 November 1998	21 August 1998
International Application Number	International Filing Date	International Earliest Priority Date

Title of Invention: Printing of Electronic Circuits and Components

Applicant: SRI International

Box PCT
Assistant Commissioner for Patents
Washington, D.C. 20231
ATTENTION: IPEA/US

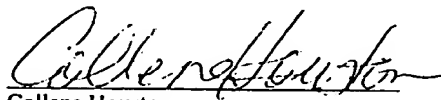
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RESPONSE TO WRITTEN OPINION

1. Applicant herewith submits replacement sheets(s) number(ed) 32 - 34 to replace sheet(s) number(ed) 32 - 34 originally filed for this application.
2. In respect of each claim appearing in the international application based on the replacement sheets submitted herewith, the following claim(s) is/are:
 - (i) unchanged: claim(s) 2 - 5, 7 - 8, 11 - 12
 - (ii) cancelled: claim(s) 17
 - (iii) new: claim(s) 0
 - (iv) replacement of one or more claims as filed, as follows: 1, 6, 9, 10, 13 - 21
 - (v) the result of the division of one or more claims as filed, as follows: 0

CERTIFICATION UNDER 37 C.F.R. 1.10*

I hereby certify that this paper and the documents referred to as being transmitted therewith are being deposited with the United States Postal Service on 27 October 2000 in an envelope as "Express Mail Post Office to Addressee" Mailing Label Number EL645030321US addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.


Collene Houston

The claims were amended as follows:

1. A method of printing an electronic component comprising:
providing a surface;
providing a redox couple comprising an oxidizer and a reducer;
solubilizing at least one of the oxidizer and the reducer in a first solution that contains no more than 5% particulates by weight;
~~applying the first solution to the surface in a desired pattern to create a first layer;~~
initiating a redox reaction in the first layer; and
completing the component by adding at least one additional layer.
6. The method of claim 1 wherein at least one of the oxidizer and the reducer comprises a metal containing compound, the metal selected from the list consisting of copper, iron, cobalt, tin, gold, silver, palladium, platinum, nickel, lithium, aluminum, and titanium.
9. The method of claim 1 wherein applying comprises depositing the first solution using at least one of a stamp[, a rotating plate,] and a jet.
10. The method of claim 1 wherein at least one of the first layer or the at least of one additional layers comprises an electrolyte.
13. The method of claim 1 wherein [the step of] initiating the redox reaction comprising radiating the applied solution with microwave radiation.
14. The method of claim 1 wherein [the step of] completing the component comprises:
providing a second redox couple comprising a second oxidizer and a second reducer;
solubilizing at least one of the second oxidizer and the second reducer in a second solution;
depositing the second solution onto the first layer, and initiating a redox reaction in the second solution.
15. The method of claim 1 wherein the component comprises a battery, and [the step of] applying comprises depositing the first solution using at least one of a stamp, a rotating plate, and a jet.

16. The method of claim 1 further comprising:
providing a second redox couple comprising a second oxidizer and a second reducer;
solubilizing at least one of the second oxidizer and the second reducer in a second
solution;
depositing successive [deposits] layers of the second solution, and initiating a redox
reaction in the successive [deposits] layers to produce a solid conductor that
electrically couples at least two of the [deposits] layers of the component that
are mutually non-adjacent.

Previously filed claim 17 was canceled, and its limitations added to claim 1.

- [19]18. A method of printing an electronic circuit comprising:
printing a plurality of components according to one of the methods of claims 1 - 16;
and
applying the first solution to the surface in a desired pattern that connects at least two
of the plurality of components, and initiating [a] the redox reaction in the
desired pattern to produce a conductive trace between the at least two
components.

Previously filed claims 20-21 were renumbered as 19-20.

I

Baum et al. – Process for Photochemical Catalysis of Electroless Copper Plating Onto Polymeric Substrates. IBM Technical Disclosure Bulletin (Nov. 1990)

The Office considers Baum to preclude patentability of previously filed claims 1, 6 - 7, 9 - 11, and 17 - 18 on the grounds of novelty. The applicant disagrees.

Claim 1, and dependent claims 6 - 7, 9 - 11, and 17 - 18 (now just 17 after renumbering because claim 17 was canceled), recite a method of printing an electronic component on a surface by a) providing a redox couple, b) solubilizing at least one of the redox components in a solution, c) applying the solution to the surface in a desired pattern, and d) initiating the redox reaction of the patterned solution.

In this application, the redox solution is initially laid down on the substrate in a specific and desired pattern. The substrate is not initially entirely coated or surrounded by the

metallic liquid/slurry. (Specification, page 16, lines 25 - 39 and page 17, lines 1 - 2) Etching procedures or lithographic masks are not used to form a metallic pattern amongst a continuous metallic film.

Baum teaches that metallic patterns are formed on a polymer substrate after the entire substrate has been coated with a metallic film. An electroless plating bath is used to completely coat the polymer substrate with the metallic film. Lithographic masks or etching procedures are used to form patterns on the substrate after the substrate is fully coated or surrounded with the plating bath solution. There is no teaching or suggestion that the electroless deposition of the metallic film can be accomplished initially as a pattern on the substrate.

Further, in the present application, photoactive catalysts are not required to drive the metallic deposition on the polymer substrate to completion.

Baum teaches the fabrication of metallic films on a polymer substrate by using catalytic electroless plating baths. The electroless plating baths are catalyzed by photoactive catalysts, such as palladium (II) salts. Baum teaches that the catalyst must be removed at some point during metallization to ensure electrical integrity and/or pattern selectivity. There is no teaching or suggestion by Baum that photoactive catalysts are merely optional in order to make this method of metallic film fabrication effective.

Therefore, the method recited in claim 1 of the present application is neither taught nor suggested by the Baum publication. Claims 6 - 7, 9 - 11, and 17 - 18 (now just 17 after renumbering because claim 17 was canceled) are dependent on claim 1, and thus are neither taught nor suggested by Baum.

II

Baum et al. - Photosensitive Circuitization of Dielectrics Via Electrolysis Plating of Metals. In: Metallized Plastics 3: Fundamental and Applied Aspects. (1992)

The Office considers Baum to preclude patentability of previously filed claims 1, 6 - 7, 9 - 11 and 17 - 18 on the grounds of novelty. The applicant disagrees.

Claim 1, and dependent claims 6 - 7, 9 - 11 and 17 - 18 (now just 17 after renumbering because claim 17 was canceled), recite a method of printing an electronic component on a surface by a) providing a redox couple, b) solubilizing at least one of the

redox components in a solution, c) applying the solution to the surface in a desired pattern, and d) initiating the redox reaction of the patterned solution.

In this application, the redox solution is initially laid down on the substrate in a specific pattern. The substrate is not initially entirely coated or surrounded by the metallic liquid/slurry. Etching procedures or lithographic masks are not used to form a metallic pattern amongst a continuous metallic film.

Baum teaches that metallic patterns are formed on a polymer substrate after the entire substrate has been coated with a metallic film. An electroless plating bath is used to completely coat the polymer substrate with the metallic film. Lithographic masks or etching procedures are used to form patterns on the substrate after the substrate is fully coated or surrounded with the plating bath solution. There is no teaching or suggestion that the electroless deposition of the metallic film can be accomplished initially as a pattern on the substrate.

Further, in the present application, photoactive catalysts are not required to drive the metallic deposition on the polymer substrate to completion.

Baum teaches the fabrication of metallic films on a polymer substrate by using catalytic electroless plating baths, which is contrary to the present application. The electroless plating baths are catalyzed by photoactive catalysts, such as palladium (II) salts. Baum teaches that the catalyst must be removed at some point during metallization to ensure electrical integrity and/or pattern selectivity. There is no teaching or suggestion by Baum that photoactive catalysts are optional in order to make this method of metallic film fabrication effective.

Therefore, the method recited in claim 1 of the present application is neither taught nor suggested by the Baum publication. Claims 6 - 7, 9 - 11 and 17 - 18 (now just 17 after renumbering because claim 17 was canceled) are dependent on claim 1, and thus are neither taught nor suggested by Baum.

III

US 5756146 issued to Lee et al. (May 1998)

The Office considers Lee et al. (Lee) to preclude patentability of previously filed claims 1, 6 - 7, 10 - 11, 14, and 17 - 18 on the grounds of novelty. The applicant disagrees.

In the present application, a metallic solution is laid down onto a substrate or surface initially in a desired and distinct pattern. Resist masks or permanent resists are not required to form the pattern on the substrate. A separate solvent wash or etching step is not required to remove any unwanted metallic solution or metallic deposits.

Lee teaches the fabrication of a metallic layer over copper or molybdenum lines on a substrate by using electroless plating baths. The metallic layer can cover the entire substrate or cover only a portion of the substrate, but the metallic layer contemplated by Lee is not laid down on the substrate in a desired pattern without the use of resist masks, permanent resists or polymer adhesion layers.

Resist masks, permanent resists, or polymer adhesion layers are used if the metallic layer is to be laid down on a portion of the substrate. The masks are designed to cover the undesirable areas of the substrate, so that the metallic layer can be applied to only the desirable layers. The masks are removed either by a solvent or by an etching procedure. The polymer adhesion layer is laid down on the substrate in the same pattern as subsequent metal layer. The polymer then reacts with the metal ions in the electroless - plating bath to form a polymer - metal bond on the substrate in the desired pattern. The polymer - metal layer stays on the substrate until removed with a solvent or etching procedure.

The metallic layer is designed for use in the inspection of the underlying copper or molybdenum lines. Once the inspection is complete, the metallic layer or polymer - metal layer, is fully removed from the substrate by using a solvent wash or an etching procedure. (Specification, column 9, lines 45 - 54)

Lee does not teach or suggest that the metallic layer can be formed directly on the substrate in a distinct and desired pattern without the use of masks, resist masks, or patterned adhesion layers. Lee also does not teach or suggest that the metallic layer can be formed on the substrate other than by use of an electroless plating bath.

Therefore, the method recited in claim 1 of the present application is neither taught nor suggested by Lee. Claims 6 - 7, 10 - 11, 14, and 17 - 18 (now just 17 after renumbering because claim 17 was canceled) are dependent on claim 1, and thus are also neither taught nor suggested by Lee.

IV

US 4775556 issued to Krause et al. (October 1988)

The Officer considers Krause et al. (Krause) to preclude patentability of previously filed claims 1 - 4, 6 - 8, 10 - 11, 14 and 17 - 18 on the grounds of novelty. The applicant disagrees.

Claim 1, and dependent claims 2 - 4, 6 - 8, 10 - 11, 14 and 17 - 18 (now just 17 after renumbering because claim 17 was canceled), recite a method of printing an electronic component on a surface by a) providing a redox couple, b) solubilizing at least one of the redox components in a solution, c) applying the solution to the surface in a desired pattern, and d) initiating the redox reaction of the patterned solution.

In this application, the redox solution is *initially laid down on the substrate in a specific and desired pattern*. The substrate is not initially entirely coated or surrounded by the metallic liquid/slurry. Etching procedures or *lithographic masks are not used* to form a metallic pattern amongst a continuous metallic film. (Specification, page 16, lines 25 - 29 and page 17, lines 1 - 2)

Krause teaches that an electro - charged pattern can be formed on a surface by a) coating the **entire** surface with an electroactive polymer, b) *masking portions of the polymer* in order to expose a desired pattern, c) injecting a charge into said polymer through the exposed area in the masking means. (Column 2, lines 46 - 60 and Example 5). There is no suggestion by Krause of depositing the electroactive polymer on the surface in a desired pattern initially and not using masking means.

As a matter of fact, after reviewing Krause, it is not taught nor suggested to forego the apparently successful and desirable masking procedure in order to lay down a desired and specific pattern, because Krause states in the Background and further in the Summary sections that the masking procedure is important to get specific areas of charged polymer. (Column 1, lines 20 - 25; Column 2, lines 29 - 42).

Therefore, the method recited in claim 1 of the present application is neither taught nor suggested by Krause. The method recited in claim 1 of the present application, including laying down a redox solution in a desired pattern without the use of masking means, would also not be obvious to an ordinary person skilled in the art. Claims 2 - 4, 6 - 8, 10 - 11, 14

and 17 - 18 (now just 17 after renumbering because claim 17 was canceled) are dependent on claim 1, and thus are also neither taught nor suggested by Krause.

V

US 4576689 issued to Makkaev et al. (March 1986)

The Officer considers Makkaev et al. (Makkaev) to preclude patentability of previously filed claims 1, 3, 6 - 11, 14, and 17 - 21 on the grounds of novelty. The applicant disagrees.

Claim 1, and dependent claims 1, 3, 6 - 11, 14, and 17 - 21 (now just 17 - 20 after renumbering because claim 17 was canceled), recite a method of printing an electronic component on a surface by a) providing a redox couple, b) solubilizing at least one of the redox components in a solution, c) applying the solution to the surface in a desired pattern, and d) initiating the redox reaction of the patterned solution.

In this application, the redox solution is *initially laid down on the substrate in a specific and desired pattern*. The substrate is not initially entirely coated or surrounded by the metallic liquid/slurry. Etching procedures or *lithographic/photoresist masks are not used* to form a metallic pattern amongst a continuous metallic film.

Makkaev teaches that electrochemical metallization of printed circuit boards is achieved by a) applying a photoresist to a board, b) wetting the board with a metallic solution, c) heat - treating the board, and d) washing the unreacted metallic solution away from the board. (Column 5, lines 64 - 68; Column 6, lines 1 - 10; Example 1). Makkaev does not teach nor suggest laying down the metallic solution on the board in a desired and distinct pattern without the assistance of a photoresist coating.

As a matter of fact, after reviewing Makkaev, it is not taught nor suggested to forego the apparently successful and desirable masking procedure in order to lay down a desired and specific pattern, because Makkaev states in the Abstract, Background and further in the Summary sections that the masking procedure is important to get specific areas of metal coating.

Therefore, the method recited in claim 1 of the present application is neither taught nor suggested by Makkaev. The method recited in claim 1 of the present application,

including laying down a redox solution in a desired pattern without the use of masking means, would also not be obvious to an ordinary person skilled in the art. Claims 3, 6 - 11, 14, and 17 - 21 (now just 17 - 20 after renumbering because claim 17 was canceled) are dependent on claim 1, and thus are also neither taught nor suggested by Makkaev and are not obvious to an ordinary person skilled in the art.

VI

Obviousness objection based on Makkaev, Krause, Lee or Baum (above addressed references)

The Office considers Makkaev, Krause, Lee and/or Baum to preclude patentability of claims 19 - 21 based on obviousness and lack of an inventive step. The applicant disagrees.

As mentioned earlier in the individual discussions of the Makkaev, Krause, Lee and Baum references, all of these cited references do not disclose or otherwise teach laying down a redox solution in a desired pattern without the use of photoresists, lithographic masks, photoactivated polymers and the like. It is not obvious at all after reading the references cited by the Officer that the solutions could be applied to the substrate in a desired pattern initially without the use of masks or resists.

In the present application, claim 1 and dependent claims 18 - 20 (cancellation of claim 17 and renumbering) recite a method of printing an electronic component on a surface by a) providing a redox couple, b) solubilizing at least one of the redox components in a solution, c) applying the solution to the surface in a desired pattern, and d) initiating the redox reaction of the patterned solution. Further, claim 18 (old claim 19) recites the step of applying the first solution to the surface in a pattern that connects at least two of the plurality of components, and initiating a redox reaction in the pattern to produce a conductive trace between the at least two components.

Therefore, it would not be obvious to one ordinarily skilled in the art after reviewing Makkaev, Lee, Krause and Baum to lay down a redox solution in a desired pattern without the use of masking means, as recited in claim 1. Claims 18 - 20 (old claims 19 - 21) are dependent on claim 1, and thus are neither taught nor suggested by Makkaev, Krause, Lee and/or Baum and further are not obvious to an ordinary person skilled in the art.

VII

Makkaev in view of US 5116582 issued to Cooper et al. (May 1992)

The Office considers Makkaev in view of Cooper et al. (Cooper) to preclude patentability of previously filed claim 13 on the grounds of obviousness. The applicant disagrees.

In the present application, a solution is laid down on a substrate in a desired pattern. The solution is photochemically reacted to form the basis of an electronic component. The redox reaction occurs in a patterned solution on a substrate.

Cooper describes a method of photochemically activating a chemical slurry with UV light. The electrons from the light source are "trapped" in the slurry, and subsequently initiate and catalyze a redox reaction.

Cooper does not teach the use of the chemically reacted slurry. Cooper does not teach using the chemically reacted slurry in conjunction with a surface or substrate. Cooper also does not teach that the slurry is photochemically reacted on a substrate or reacted after its been laid down on the substrate in a desired pattern.

Makkaev teaches that electrochemical metallization of printed circuit boards is achieved by a) applying a photoresist to a board, b) wetting the board with a metallic solution, c) heat - treating the board, and d) washing the unreacted metallic solution away from the board. (Column 5, lines 64 - 68; Column 6, lines 1 - 10; Example 1). Makkaev does not teach nor suggest laying down the metallic solution on the board in a desired and distinct pattern without the assistance of a photoresist coating.

As a matter of fact, after reviewing Makkaev, it is not taught nor suggested to forego the apparently successful and desirable masking procedure in order to lay down a desired and specific pattern, because Makkaev states in the Abstract, Background and further in the Summary sections that the masking procedure is important to get specific areas of metal coating.

It is not obvious to one skilled in the art to use the information disclosed in Cooper, which is photochemically reacting a slurry in a reactor casing, to produce the subject matter of claim 1 and the following dependent claims, including claim 13, of the present invention.

Further, it is not obvious to one skilled in the art of the information disclosed in Cooper and Makkaev to contemplate laying down a redox solution in a desired pattern initially on a substrate or other surface without the use of photoresists, masks and the like. Therefore, the method recited in claim 1 of the present application is neither taught nor suggested by Makkaev in view of Cooper. The method recited in claim 1 of the present application, including laying down a redox solution in a desired pattern without the use of masking means, would also not be obvious to an ordinary person skilled in the art. Claim 13 is dependent on claim 1, and thus is neither taught nor suggested by Makkaev in view of Cooper and is not obvious to an ordinary person skilled in the art.

VIII

US 4,079,156 issued to Youtsey (March 1978)

The Office considers Youtsey to preclude patentability of claims 1 - 7, 10 - 12, and 19 - 21 (renumbered as claims 18 - 20 because of cancellation of claim 17) based on lack of inventive step and obviousness. The applicant disagrees in view of the inclusion of the limitations of claim 17 into claim 1.

IX

US 4,517,227 issued to Cassat (May 1985)

The Office considers Cassat to preclude patentability of claims 9 and 15 based on lack of inventive step and obviousness. The applicant disagrees.

Claims 9 and 15 are claims that are dependent on independent claim 1. Therefore, claims 9 and 15 include all of the provisions of claim 1. The Officer did not object to claim 1 in view of Cassat, and therefore, claims 9 and 15 are allowable in view of Cassat by virtue of their dependency on claim 1.

X

Certain Observations on the International Application

In claim 1, the term "the" is added directly in front of the term "reducer" as the Officer has suggested. There is no new matter added to claim 1 by virtue of this amendment.

In claim 6, the term "the" is added directly in front of the term "reducer" as the Officer has suggested. There is no new matter added to claim 6 by virtue of this amendment.

The applicant disagrees with the Officer's generalization and broadening of the phrase "desired pattern". The term "pattern" does not lend itself to being defined as "complete coverage" of a surface, as the Officer has suggested. The application itself defines "pattern" as the following:

"The patterns contemplated to be dispensed using apparatus and methods described herein include any arrangement of points or dots, whether isolated or combined to form lines, filled in spaces and so forth. Thus, contemplated patterns include straight and curved lines, intersections of lines, lines with widened or narrowed areas, ribbons, overlapping lines. It is especially contemplated that useful patterns may include circuit board and circuit component designs. The patterns may also be single or multi - layered designs, and may involve printing on one or both sides, with vias being printed to interconnect the two sides." (Emphasis added)

Given the description of a contemplated pattern shown above, it is obvious that the applicant did not intend the term pattern to mean an area that is completely covered with no discernable pattern, as the Officer suggests.

Second, the Officer suggests that the relationship between the "desired pattern" and the printing is not clearly claimed. The applicant again disagrees. Claim 1 clearly states "applying the first solution to the surface in a desired pattern to create a first layer." The term "applying" encompasses the term "printing", since printing is the application of an ink or other ink - like material.

The Officer objects to the term "active" in Claim 2, as not having "metes and bounds". The applicant disagrees.

The term "active" with respect to "component" is clearly defined and distinguished from passive components on page 8, lines 15 - 23 of the specification:

"Electronic components contemplated herein may be classified in many different ways, including classification into active components and passive components. Active components are electronic components capable of some dynamic function, such as amplification, oscillation, or signal control, which usually requires a power source for its operation. Examples are bipolar transistors, field - effect transistors, and integrated circuits. Passive components are electronic components that are basically static in operation, i.e., are ordinarily incapable of amplification or oscillation, and usually require no power for

their characteristic operation. Examples are conventional resistors, capacitors, inductors, diodes, rectifiers and fuses.” (Emphasis Added).

The Officer objects to the term “integrated” in Claim 3, as lacking proper “metes and bounds”. The applicant disagrees.

The term “integrated” with respect to “component” is clearly defined and distinguished from discrete components on page 9, lines 12 - 18 of the specification:

“Still further, electronic components contemplated herein may also be classified as discreet or integrated. Discreet components are devices that offer one particular electrical property concentrated at one place in a circuit. Examples are resistors, capacitors, diodes, and transistors. Integrated components are combinations of components that that can provide multiple electrical properties at one place in a circuit. Examples are ICs, i.e., integrated circuits in which multiple components and connecting traces are combined to perform multiple or complex functions such as logic.”

The Officer objects to the term “strong” in Claim 7, as lacking proper “metes and bounds”. The applicant disagrees.

The term “strong” with respect to “oxidizers and reducers” is generally accepted by those skilled in the art of chemistry and organic chemistry as those oxidizers and reducers that react or are initiated spontaneously or without significant energy from an outside energy source. Metes and bounds are associated with the term “strong” by those ordinarily skilled in the art of chemistry.

The Officer objects to the term “pure” in Claim 11, as lacking proper “metes and bounds”. The applicant disagrees.

The same argument that is made for the term “strong” when associated with “oxidizers and reducers” can also be made for the term “pure” when associated with the term “metal”. Those ordinarily skilled in the art of chemistry and metallurgy understand what the phrases “pure metal”, “essentially pure metal”, and “substantially pure metal” mean and consider those terms to have metes and bounds within the art.

In claim 9, the phrase “the step of” is deleted. There is no new matter added to claim 9 by virtue of this amendment. Further, claim 9 is amended to remove the phrase “a rotating

plate", as the Officer has suggested. Based on the amendment to claim 9, the Officer's "clarity" objection to claim 9 has been rendered moot. No new matter is added by virtue of this amendment to claim 9.

Claim 10 is amended to include the wording "wherein at least one of the first layer or the at least of one additional layers comprises an electrolyte" as suggested by the Officer. No new matter is added to claim 10 by virtue of this amendment.

In claim 13, the phrase "the step of" is deleted. There is no new matter added to claim 13 by virtue of this amendment.

In claim 14, the phrase "the step of" is deleted. There is no new matter added to claim 14 by virtue of this amendment. Further, in claim 14, the term "the" is added directly in front of the phrase "second reducer" as suggested by the Officer. There is no new matter added to claim 14 by virtue of this amendment.

In claim 15, the phrase "the step of" is deleted. There is no new matter added to claim 15 by virtue of this amendment.

In claim 16, the term "the" is added directly in front of the phrase "second reducer" as suggested by the Officer. There is no new matter added to claim 16 by virtue of this amendment. Further, in claim 16 the term "deposits" is replaced by the term "layers" as the Officer has suggested. There is no new matter added to claim 16 by virtue of this amendment.

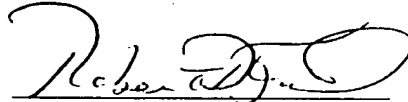
Applicant notes that Officer considers previously filed claims 17 and 18 to include no particulates being present in the solutions and layers.

Previously filed claim 19 (renumbered as claim 18) is amended to add the term "desired" directly in front of the term "pattern" as the Officer has indirectly suggested. There is no new matter added to claim 19 by virtue of this amendment. Further, claim 19 (renumbered as claim 18) is amended to replace the phrase "a redox reaction" with the phrase "the redox reaction", as the Officer has suggested. There is no new matter added by virtue of this amendment.

The Officer is incorrect in her assertion regarding claim 1, claim 19 (renumbered as claim 18) and the connection of electrical components. The specification, claim 1 and claim

19 (renumbered as claim 18) say nothing to the effect that each electrical component has to be contained on a different surface from another electrical component. It is entirely foreseeable and expected by one ordinarily skilled in the art of electronics that one surface can contain several different electrical components. All claim 1 recites is that a surface must be provided. Claim 1 does not say that the surface provided has to be free of other electrical components.

Sincerely,

A handwritten signature in black ink, appearing to read "Robert D. Fish", written over a horizontal line.

Robert D. Fish
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CLAIMS

What is claimed is:

1. A method of printing an electronic component comprising:
providing a surface;
providing a redox couple comprising an oxidizer and a reducer;
solubilizing at least one of the oxidizer and the reducer in a first solution that contains
no more than 5% particulates by weight;
applying the first solution to the surface in a desired pattern to create a first layer;
initiating a redox reaction in the first layer; and
completing the component by adding at least one additional layer.
2. The method of claim 1 wherein the component comprises is an active component.
3. The method of claim 1 wherein the component comprises an integrated component.
4. The method of claim 1 wherein the component comprises a power source.
5. The method of claim 1 wherein the component comprises a battery.
6. The method of claim 1 wherein at least one of the oxidizer and the reducer comprises a metal containing compound, the metal selected from the list consisting of copper, iron, cobalt, tin, gold, silver, palladium, platinum, nickel, lithium, aluminum, and titanium.
7. The method of claim 1 wherein the oxidizer is a strong oxidizer and the reducer is a strong reducer.
8. The method of claim 1 wherein the redox couple includes a material selected from the list consisting of formate, nitrate, alkoxide nitrate, alkoxide perchlorate, acetate nitrate, acrylate nitrate.
9. The method of claim 1 wherein applying comprises depositing the first solution using at least one of a stamp and a jet.
10. The method of claim 1 wherein at least one of the first layer or the at least of one additional layers comprises an electrolyte.

11. The method of claim 1 wherein the redox reaction results in the first layer consisting essentially of a pure metal.
12. The method of claim 1 wherein the redox reaction results in the first layer consisting essentially of a mixed metal oxide.
13. The method of claim 1 wherein initiating the redox reaction comprising radiating the applied solution with microwave radiation.
14. The method of claim 1 wherein completing the component comprises:
providing a second redox couple comprising a second oxidizer and a second reducer;
solubilizing at least one of the second oxidizer and the second reducer in a second solution;
depositing the second solution onto the first layer, and initiating a redox reaction in the second solution.
15. The method of claim 1 wherein the component comprises a battery, and applying comprises depositing the first solution using at least one of a stamp, a rotating plate, and a jet.
16. The method of claim 1 further comprising:
providing a second redox couple comprising a second oxidizer and a second reducer;
solubilizing at least one of the second oxidizer and the second reducer in a second solution;
depositing successive layers of the second solution, and initiating a redox reaction in the successive layers to produce a solid conductor that electrically couples at least two of the layers of the component that are mutually non-adjacent.
17. The method of any of claims 1 -16 wherein the first solution applied to the surface contains no more than 2% particulates by weight.
18. A method of printing an electronic circuit comprising:
printing a plurality of components according to one of the methods of claims 1 - 16;
and

applying the first solution to the surface in a desired pattern that connects at least two of the plurality of components, and initiating the redox reaction in the desired pattern to produce a conductive trace between the at least two components.

19. The method of claim 17 wherein the pattern has a lateral resolution below 10 μm .
20. The method of claim 17 wherein the circuit includes a transistor, a power source, and a capacitor.